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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/809,276	03/25/2004	Prabhakaran K. Centala	05516/148002	6042

7590 04/16/2008

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EXAMINER	
SAXENA, AKASH	

ART UNIT	PAPER NUMBER
2128	

MAIL DATE	DELIVERY MODE
04/16/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/809,276	CENTALA ET AL.	
	Examiner	Art Unit	
	AKASH SAXENA	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 June 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2-23,25-38,40 and 45-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-23, 25-38, 40, and 45-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 July 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/10/07*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-48 have been presented for examination based on applicant's preliminary amendment of 26 June 2007 and disclosure filed 4 February 2004.
2. Claims 42 and 43 are canceled.
3. Claims 2-23, 25-38, 40, and 45-48 remain pending in this application and stand rejected by the examiner.
4. This action is made FINAL.

Response to Objection to Drawings

5. Drawings presented on 25th July 2007 are accepted.

Response to Double Patenting Rejection

6. Double Patenting rejection to US Patents 6785641 and 6516293 is withdrawn in view of terminal disclaimer filed (6/26/07) and accepted on 6th July 2007.

Response to Claim Rejections - 35 USC § 101

7. Claims 45-48 now recite the step of "outputting" thereby curing lack of concrete and tangible result. The rejection is therefore withdrawn.

Response to Claim Rejections - 35 USC § 112

8. Rejection for claims 42 and 43, rejected under 35 U.S.C. 112 is moot in view of their cancellation.
9. Rejection for claims 11-13 is withdrawn in view of amendment.

Response to Claim Rejections - 35 USC § 102

10. Examiner disagrees with applicant that Chen fails to teach certain limitation. Applicant's arguments are considered and the rejection is clarified below.

Response to Claim Rejections - 35 USC § 103

A. Claims 2-7 and 45-48 are rejected under 35 U.S.C. § 103(a) with Ma

(Argument 1) Applicant has argued in Remarks Pg.17:

> For example, with respect to claims 45 and 46, the Ma book fails to show or suggest evaluating radial forces based on a selected criterion and adjusting at least one parameter of the selected drill bit based on the evaluating. As disclosed in the present application, the selected criterion may include, for example, a ratio of the resultant radial force to the applied weight on bit (WOB). The Ma book fails to show or suggest a method or criterion for evaluating radial forces on a drill bit of bottomhole assembly.

(Response 1) In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., ratio of resultant radial force to applied Weight on Bit (WOB)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Arguendo, even if the argued limitation is read as presented by applicant, Examiner respectfully disagrees, as Ma teaches this In Section 5.3 on Pg. 202, drilling weight is the WOB:

The holder is made from two layers of steel plates. The rock is holded on the upper layer. The lower layer is connected to the supporting shaft to accept the thrust from the cylinder, and the torque from the rotary plate. There are three vertical poles and three horizontal poles for suspending the upper layer on the three short supporting poles in the edge of the lower layer. These six poles are connected by the ball hinges, belonging to the pole applied with two forces in the mechanics. The six freedoms on the upper platform are constrained by the six poles, which is fixed relative to the lower platform. By measuring the forces applied on the six poles with electro-resistant strainfoils, we can obtain the drilling weight and torque. As the six poles are rotated together with the holder, the electro-mea-

(Argument 2) Applicant has argued in Remarks Pg.10:

> Further, with respect to claim 47, the Ma book fails to show or suggest graphically displaying the radial forces determined during a simulation **[1]** and adjusting at least one parameter of the drill bit based on the graphical display of the radial forces **[2]**.

(Response 2) As per **[1]**, Examiner disagrees as Ma teaches simulation and computation of forces acting on the drill bit (Ma: Section 5.3 “Simulation Test of the crater forming process by bit teeth" and at least on Pg.202 – as shown on previous page). Ma acknowledges that computer aided simulation and display is anticipated (Ma: Pg.207)

> model for the shape of craters, area size and volume it is still in research. The mathematics with high relativity for the craters as the result of individual combination of bits and rocks have been established now. Some widely used models are still in research. The computer simulation program for the breaking rock process of roller cone bit will be realized before long. The test machine is the key device for promoting this high technology. We expect that every bit manufacturer and design research unit can sufficiently utilize the machine for the separate test to promote the development of the roller cone bits.

What is known in the art are display of such simulation (See Chen and Warren). Hence it would be obvious to one skilled in the art to display the bottom-hole and bit interaction as well (Ma: Pg.214):

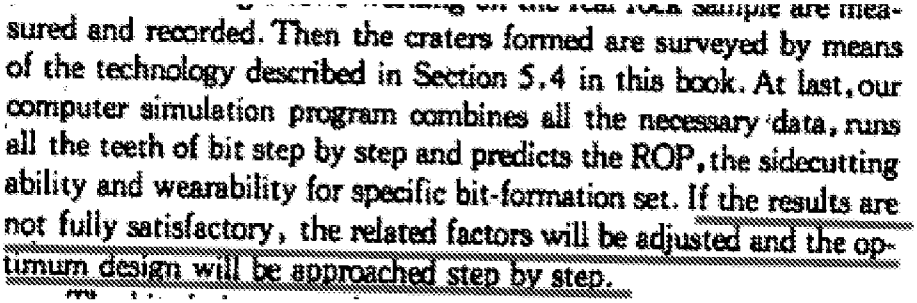
> eight grades of elevation. The upper and lower limit for each grade of elevation, their holding area and total area percentage are listed in Table 5 – 7. For understanding the situation in detail, we determine the elevation freely, and divide them into eight grades. For example, dividing two lower grades in Fig. 5 – 29, the dark green and dark blue that means from-10.45 to-17.70, into eight contour picture in detail, the result is shown in Fig. 5 – 30. The corresponding for the eight grades is shown in Table 5 – 8. While the image is displayed at the monitor, the corresponding data is displayed at the computer color screen, and printed on the printer.

As per **[2]**, examiner disagrees as Ma *Section 6.1.2.3* titled "6.1.2.3 Adjustment of Cutting Structure With Element Tests and Determination of Bit Performance" teaches adjusting at least one parameter of the drill bit based on the graphical display [e.g. of bottom hole pattern and bit design – see above] of the radial forces. Further such display is known in the art as is shown by Warren also (Warren: Fig.15 Showing radial force Fr and WOB in Fig.16).

(Argument 3) Applicant has argued in Remarks Pg.10:

> With respect to claim 48, the Ma book fails to show or suggest obtaining a first and a second set of radial forces of a first and second bit design, respectively, and evaluating the first and second set of radial forces based on a selected criterion.

(Response 3) Ma teaches iterative design approach – See Section 6.1.2.3.



sured and recorded. Then the craters formed are surveyed by means of the technology described in Section 5.4 in this book. At last, our computer simulation program combines all the necessary data, runs all the teeth of bit step by step and predicts the ROP, the sidecutting ability and wearability for specific bit-formation set. If the results are not fully satisfactory, the related factors will be adjusted and the optimum design will be approached step by step.

The forces are computed by Ma as shown above (referring to Ma: section 5.3).

B. Claims 8-9 are rejected under 35 U.S.C. § 103(a) with Ma in view of Warren

Arguments presented against Ma are addressed above. No arguments were presented against Warren.

C. Claims 1-23 and 25-35 are rejected under 35 U.S.C. § 103(a) with Ma in view of Glass

Arguments presented against Ma are addressed above. No arguments were presented against Glass.

Claim Rejections - 35 USC § 102

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. **Claims 2-7, 40, 42, 43, and 45-48 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,412,577 issued to Chen.**

Regarding claims 2-6, 40, 42, 43, 45-48: Chen discloses drill bit design (fixed and roller, Figs. 11, 12) by simulating roller cone earth drilling including calculating roller cone element geometry (forces)and selecting drilling parameters (CL7-L26-29, Figs. 1A-C), and simulated earth formation drilling (CL9-L44, CL10-L2-15). Chen further discloses calculating forces on cutting elements (Abstract, CL7-L48-47, Fig. 1C, compressive forces: CL3-L52-67), simulating an incrementally rotating bit (CL7-L30-47), and recalculating cutting element forces based on design parameter to meet design criteria and optimizing performance (CL12-L25-28). Chen further discloses graphically displaying resulting design parameters (CL7-L29, 47, CL12-L25-41).

Specifically Regarding claim 45, Chen teaches determining all forces (including radial force) acting on the drill bit during simulation (CL1 L29-58, C7 L48-67 CL4 L7-36); evaluating the radial forces based on at least on selection criteria as determining forces based on WOB, which changes based on rock type (*CL1 L29-58); adjusting at least one parameter of the selected drill bit based on evaluating (CL5 L15-18; CL12-L25-28) and outputting a drill bit design based on the evaluating*

and the adjusting (CL12-L15-46; Fig.8A-B optimization; Fig.9A-C). Claims 46 and 47 are rejected similarly.

Additionally Regarding claim 47, Chen teaches graphically displaying radial velocity during the simulation (Fig.2 & CL8 L40-49). It is known in the art change in velocity is linearly proportional to force (Force = mass (constant) x velocity/time).

Additionally Regarding claim 48, Chen teaches iterative approach in calculating force for designs (C12 L43-67).

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Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. **Claims 2-7 and 45-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over "The Operational Mechanics of The Rock Bit", Ma et al, Petroleum Industry Press, Copyright 1996.**

The Ma reference is a study of the dynamics of the interaction between the roller cone drill bit and rock (earth) including bit geometry, kinematics, axial loading, and the balancing (equalization) of forces acting on a roller cone drill bit. In particular, Chapter 6, and to some degree Chapter 5, of Ma sets forth the elements of what he refers to as the "New Methodology" for roller cone bit design. This "New Methodology" includes the use of drilling simulation and computer modeling for optimizing the parameters relating to the design of new roller cone drill bits. (See: page 1, paragraph 2, for condensed overview).

The examiner submits that the teachings of Ma render obvious the claimed limitations of the instant invention as presently claimed as follows:

Regarding independent claim 45: A method for designing a drill bit, comprising:

- determining radial forces acting on a selected drill bit during simulated drilling; (6.1, 6.1.2.3, 5.3, 3.3 - 3.5, Ma discloses drilling simulation, forces acting on roller cones at least at pages 128, 129, section 5.1)

- evaluating the radial forces based on at least one selected criterion; (Ma teaches forces acting on roller cones at least at pages 128, 129, section 5.1, which would be an inherent part of optimizing the 3-D load model using finite element analysis disclosed in sections 6.1-6.2.3 of Ma. (especially, 6.1.1.5))

- adjusting at least one parameter of the selected drill bit based on the evaluating; (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11, Ma sets forth adjusting design parameters)

Regarding independent claim 46: A method for designing a bottom hole assembly, comprising:

- determining radial forces acting on a bottom hole assembly during simulated drilling, said bottom hole assembly including a drill bit. (6.1, 6.1.2.3, 5.3, 3.3 - 3.5, Ma discloses drilling simulation, forces acting on roller cones at least at pages 128, 129, section 5.1, and a bottom pattern modeling at least in Figures 5-20 to 5-32)

- evaluating the radial forces based on at least one selected criterion; (Ma teaches forces acting on roller cones at least at pages 128, 129, section 5.1, which would be an inherent part of optimizing the 3-D load model using finite element analysis disclosed in sections 6.1-6.2.3 of Ma. (especially, 6.1.1.5))

- adjusting at least one parameter of the bottom hole assembly based on the evaluation (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11, Ma sets forth adjusting design parameters)

Regarding independent claim 47: A method for designing a bit, comprising:

- determining radial forces acting on a selected drill bit during a simulated drilling in selected earth formation; (6.1, 6.1.2.3, 5.3, 3.3 - 3.5, Ma discloses drilling simulation, forces acting on roller cones at least at pages 128, 129, section 5.1)

- graphically displaying the radial forces determined during the simulation; Ma teaches forces acting on roller cones at least at pages 128, 129, section 5.1. The ability to graphically display the results would have been a standard feature available on any computer system at the time of the invention, and hence would have knowingly been implemented by any skilled artisan tasked with realizing a drill simulation result on a digital computer system.

- adjusting at least one parameter of the drill bit based on the graphical display of the radial forces. (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11, Ma sets forth adjusting design parameters)

Regarding independent claim 48: This claim merely requires a comparison of forces between a first and second bit simulation in selecting a preferred design using the same features noted above. This feature is rendered obvious by Ma since Ma discloses that simulations steps should be run "again and again" to achieve an optimum design (6.2.3, especially page 234, para:1). Hence a skilled artisan would have known to use multiple (first and second) simulations in determining a preferred design.

Hence, it would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to realize the elements of the present invention as currently claimed. An obvious motivation exists since Ma teaches that the elements as claimed, and noted above, can be combined in order to find an optimum design and avoid bit (breakage) failure (chapter 6, section 5.4, especially page 232, based on the entire teaching).

Per claims 2-7: Ma renders obvious elements relating to performance parameters and cutting element interaction of a roller cone bit as noted above (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11)

13. **Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable in further view of "Drag-Bit Performance Modeling, Warren et al, SPE Drilling Engineering, June 1989"**

Analogous art Warren renders obvious elements of the present invention relating to simulating the fixed cutter drill bit drilling an earth formation; (pp. 119, col. 1, para:3-7, pp. 126, col. 1, para:2 to col. 2, para:3, Fig. 6) and determining a cutter-formation interaction force, relative sliding velocity, and cutting surface parameters on a cutter of the fixed cutter drill bit (pp. 19, col. 1, para:6, 7, pp. 126, col. 1, para:2 to col. 2, para:3, Fig. 6, Fig. 6). Hence a skilled artisan would have knowingly modified the teachings of Ma with the teachings of Warren, motivated using the same reasoning as previously cited above, to implement a fixed cutter drill bit.

14. **Claims 10-23, and 25-38 are rejected under 35 U.S.C. 103(a) as being unpatentable in further view of U.S. Patent 6,695,073 issue to Glass et al.**

Regarding claims 10-23, and 25-35: This group of claims includes limitations relating to summing radial (lateral) forces and comparing the forces to an applied WoB to generate a ratio of the sum and forces. Analogous art Glass renders obvious these limitations by disclosing programmed calculations of summed orthogonal cutter forces inclusive of weight-on-bit. (CL4-L27-46) The recited box-whisker plot is simply a well-known convenient way of graphically depicting a number summary, which consists of the smallest observation, lower quartile, median, upper quartile, and largest observation (See: CRC, or Wikipedia, for example) and hence would have knowingly been implemented by a skilled artisan in order to graphically depict the summed forces.

Regarding claims 36-38: Ma teaches adjusting bit design parameter (Section 6.1.2.3) and bit parameters (Ma: Chapter 2).

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Conclusion

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Communication

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AKASH SAXENA whose telephone number is (571)272-8351. The examiner can normally be reached on 9:30 - 6:00 PM M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini S. Shah can be reached on (571)272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Akash Saxena/
Examiner, Art Unit 2128

/Hugh Jones/
Primary Examiner, Art Unit 2128